CHAPTER 4

THE FIRST URBANIZATION

1. PRELIMINARY REMARKS

Before we proceed to the question of the possibility of the making of exact science—specially of mathematics and astronomy—in our First Urbanization, it is desirable to have some idea of the First Urbanization itself.

After the discovery of Harappa and Mohenjo-daro, excavations and explorations of about the last six decades—inclusive of the work done in Pakistan—have considerably extended our idea of the frontiers of the Indus civilization. So also have increased the nature and number of controversies about it. An important reason for the controversies is already noted. The Indus script remains undeciphered, notwithstanding many claims to the contrary. Compared to Egypt and Mesopotamia, we are not in possession of any literary document giving direct knowladge of such features of the Harappan culture as its soci - political organization or general intellectual climate. As the Allchins rightly put it, "for any society lacking written records or whose script is still undeciphered, evidence of such matters as political conditions is clearly hard to come by, and is at best inferential".[1] On such matters, therefore, we are left with the choice between dependable inferences and less dependable ones, or between sound and comparatively less sound presumptions based on materials unearthed, combined often with circumstantial evidences.

In any case, our starting point is the body of the material evidences, about which there is no scope for conjecture.[2]

2. EXTENT AND POPULATION

In 1972, M. R. Mughal[3] observes :

> The evidence shows that the area covered by the Indus Civilization was larger than any of the known civilizations of the ancient world.

1. B & R. Allchin, BIC 129n.
2. Though, in this connection we have to note the observation of D.K. Chakrabarti in EIP 206 that there is sometiems discripancy even between the actual data and published reports about some of the sites.
3. M.R. Mughal, in Possehl's ACI 91.

Starting from the borders of Afghanistan, in northern Baluchistan (at Periano Ghundai), and the Iranian border on the Makran coast (at Sutkegan-Dor), it extended east and south-east and covered the entire Makran coast, the Greater Indus Valley and Gujarat. Beyond the vast plain of the Punjab, including that part which was formerly drained by the Ghaggar-Hakra river, remains of the Indus culture have also been found near Delhi in the Ganges-Yamuna doab. This enormous area could not have been limited to only 144 sites (the number so far securely identified) and, indeed, claims have been made for the discovery of twentyseven sites of Harappan affinity in east Punjab and the Doab near Saharanpur.

In 1983, the Allchins give us an approximate measurement of the area : "The area enclosed by a line joining the outermost sites at which the material culture of this civilization has been discovered is little less than half a million square miles, considerably larger than modern Pakistan".[4]

It is true that within this vast area of about 500,000 square miles, some of the sites where the remains of the Indus culture have been found "were probably ports or trading posts situated in an otherwise separate culture region"[5] while some others like those "in the Kutch and Saurashtra area, and those which penetrated into the doab represent later movements of the people from the Indus Valley proper".[6] Admitting all this, the area covered by the civilization has still to be considered as quite vast.

In 1979, D. K. Chakrabarti wants to go into some detail of this vast area : "There is no detailed gazetteer of the Harappan sites available and most of the sites are only perfunctorily reported. Pande and Ramachandran listed 258 sites in 1971. While some sites ... should now be added to the list there is no assurance that all of these 258 sites should strictly come under the category of the Harappan".[7] Such difficulties notwithstanding, Chakravarti—depending on published data—gives us a list of some of the major Harappan settlements along with their size estimated in square metres. We give below a synopsis of his list :[8]

4. B. & R. Allchin, RCIP 167.
5. *Ibid* 167.
6. M.R. Mughal, in Possehl's ACI 91.
7. D.K. Chakrabarti in EIP 205.
8. *Ibid* 210-212.

Site	*Size in Square Metres*	*Site*	*Size in Square Metres*
Mohenjo-Daro	848058 (or roughly 850000)	Rahman Dheri	189070 (or 200000)
Ali Murad	101840 (or 100000)	Harappa	850000
Chanhu-Daro	64752 (or 65000)	Vainiwal	73872 (or 75000)
Karchat	47196 (or 50000)	Ahmad Khan Dheri	20748 (or 20000)
Lohum-jo-Daro	49886 (or 50000)	Dewalina Ther	215364 (or 222000)
Nokjo-Shadinzai	75076 (or 75000)	Lure-wala	819200 (or 820000)
Mehi	99029 (or 100000)	Trekoe	417195 (or 420000)
Pandi Wahi	14522 (or 15000)	Qadar-wali Ther	53144 (or 55000)
Thano-Bula-Khan	14934 (or 15000)	Sandhan-wala Ther	53144 (or 55000)
Kotasur	91790 (or 90000)	Kali-bangan	140210 (or 150000)
Naru-Waro-Dharo	347234 (or 350000)	Lothal	46938 (or 47500)
Theri Bahadur Shah	38120 (or 40000)	Kanjetar	23104 (or 20000)
Judeir-jo-Daro	250436 (or 250000)	Kindar-khera	8281 (or 10000)
Kot Diji	22022 (or 22000)	Devaliyo	318384 (or 320000)
Sutka-gendor	17819 (or 20000)	Bhim-patal	11011 (or 10000)
Dabar-kot	187827 (or 200000)	Akru	40200 (or 40000)
		Malva	18291 (or 20000)
		Surkotada	26000
		Kotadi	140000

Attempt has also been made to estimate the possible population of these. Here is how Chakrabarti[9] sums it up :

Taking the population estimates for Mohenjo-daro as an index one may speculate on the number of sites which were likely to contain at least more than 5000 people. There are three estimates for the population of Mohenjo-daro... On the basis of his estimate of the

9. *Ibid* 206. Compare population estimate in major Mesopotamian sites in Childe WHH 94.

quantity of grain stored in the granaries, which, he thought, was used only for the general civic consumption, Datta [gives] a total population of 33,469 for Mohenjo-daro ... Allowing a ratio of 800 square feet per person, Fairservis put the total population of Mohenjo-daro at 41,250 and considered this figure to be on the conservative side. ... On the basis of a nineteenth century statistics for Shikarpur in north-west Sind, which he thought, closely resembled Mohenjo-daro both in dimensions and lay-out, Lambrick estimated the total population of Mohenjo-daro to be 35,000.

Accepting Lambrick's estimate of 35,000 people in Mohenjo-daro with an area of 850,000 square metres, and "assuming that the density of population in other settlements was more or less the same, one feels that the settlements having an area of 1,25,000 square feet or more were likely to possess 5,000 or more people each".[10] Besides Mohenjo-daro and Harappa, a considerable number of other settlements answers to this. As Chakrabarti observes, "One can possibly say with some emphasis that there were at least 15 Harappan settlements with more than 5,000 people each. The number is likely to be somewhat more when the full data are available for most of the sites".[11]

3. AGRICULTURAL SURPLUS

This naturally raises the question of the basic substance of the city dwellers. A fraction of the population of the comparatively larger settlements could have been direct producers of food—perhaps cultivating the tract of land which every Harappan settlement is sometimes presumed to have around it.[12] But it is impossible to imagine that the city dwellers themselves produced all the food they required, for there must have been fulltime specialists among them engaged in other occupations. According to Fairservis,[13] the composition of the non-agricultural population of Mohenjo-daro was as follows : A) *Administrative* —(1) Priests, (2) Scribes and Seal cutters, (3) Musicians and dancers, (4) Engineers; (B) *Productive*—(1) Potters, (2)

10. D.K. Chakrabarti in EIP 206.
11. *Ibid* 207.
12. *Ibid* 209.
13. Fairservis in Possehl's ACI 84. Fairservis also gives his idea of the estimated population of the Indus cities : *Ibid* 83.

Weavers, (3) Brick-makers, (4) Masons, (5) Carpenters, (6) Metallurgists and (7) Traders.

This might or might not have been true of all the Harappan settlements, though in this connection it may be worthwhile to remember the following :[14]

> What also seems striking is an almost obvious fact that the basic elements of the Harappan planning seem to be present in all settlements, big or small. At one end of the scale there are sites like Mohenjo-daro and Harappa with their large population and the classic elements of the Harappan civilization while at the other end there are sites like Sutkagendor and Kot Diji which are among the small Harappan settlements with hardly more than a thousand inhabitants and yet possessing some of those distinctive traits of planning which are associated with the largest settlements ... Surkotada was hardly larger than any of these. It contained not merely evidence of systematic planning but also two inscribed seals ... Rao's claim for a population of 15,000 notwithstanding, Lothal was unlikely to have contained more than 2000-2500 people and yet this stands out as a magnificent example of Harappan urban planning and cultural traits. ...Chanhu-daro was not much larger and surely did not contain more than 5000 people on the existing evidence but all the basic traits of a Harappan settlement were here.

Admitting this, are we not permitted also to presume basically the same composition of non-agricultural population in most of the major settlements in Harappan culture? In any case, there seems hardly any scope to doubt that the vast number of city dwellers in the major Harappan settlements—particularly the resident specialists who, in order to specialise, had themselves to be relieved of the direct responsibility of food production—must have subsisted on the surplus produced by the villagers and channelised to the cities. In short, without the assumption of an accumulation of enormous amount of agricultural surplus, it is impossible for us to understand the ancient cities of the Indus.

This brings us to the point which, on Gordon Childe's analysis, forms the first or the most essential precondition for understanding the urban revolution. In recent years, however, there is the feeling among a section of sociologists that Gordon Childe's view must be resisted all along the line. The feeling seems to be prompted by factors more than barely academic.

14. D.K. Chakrabarti, in EIP 207-208.

Gordon Childe's view has its immediate political implications. The production of agricultural surplus and its extraction from the direct producers is inextricably related to the phenomenon of class formation and of the origin of state machinery in service of the privileged classes—an implication politically distateful to many. Hence is the need felt to reject Gordon Childe's view and offer substitutes to it. Unfortunately, these sociologists, in spite of being unanimous in opposing Gordon Childe, have failed to find an agreed alternative to it. Fortunately, however, it is not necessary for our present purpose to digress into the details of this recent controversy. All that needs basically to be said about it, is already very lucidly said by R. S. Sharma.[15] As he observes :

> The effort to eliminate class and surplus has introduced 'elite', 'status', 'hierarchy', 'decision-making', etc. in their place. The theory of surplus is rejected on the ground that people do not produce more on their own but are compelled to put in more work or more people are mobilized for work. Whatever motives be assigned for producing more—and this will differ from society to society—almost all types of serious investigators admit that only extra produce can support wholetime administrators, professional soldiers, full-time priests, craftsmen and other similar specialists who do not produce their food themselves. The argument that people were compelled to produce more would imply the existence of an organized coercive authority such as the state or at least a protostate represented by a strong chief, but it would not negate the idea of surplus. With increase in production, voluntary or reciprocal gifts made by kinsmen in a tribal set-up marked by low productivity are perverted and converted into compulsory or unilateral payments, for producers are forced to part with a portion of their produce. Whatever be the methods of making people pay, it is clear that these can succeed only when the capacity to pay is created. Surplus plays a key role in the formation of class and leads to the erection of an entirely new type of power structure called the state.

4. POSTULATE OF CENTRALISED POLITICAL POWER

All this leads us to the question of some centralised political power in the vast Indus Valley Civilization.

The imposing granaries unearthed at Mohenjo-daro and subsequently also at Harappa—with a total floor space of over

15. R.S. Sharma, MCSFAI. Intro. p. xv.

800 square metres at both the sites[16]—give us some idea of where the surplus on which the citizens subsisted was stored. However, in default of any telltale evidence for the nature of the machinery used for extracting the surplus from the direct producers, there are controversies about it. Without trying to enter here into these controversies, it is perhaps permissible to observe that whatever might have been the nature of this, the need for postulating some central political power or state structure cannot be evaded. At the presest stage of our discussion, we only quote some of the views expressed on the general need felt for assuming some centralised political power without trying to specify nature.

In 1950, Piggott[17] observes,

> Within the area already described, the uniform products of the Harappa civilization can be traced with the monotonous regularity of a highly-organized community under some strong system of centralized government, controlling production and distribution and no doubt levying a system of tolls and customs throughout the territory under its rule. As we shall see, there is no evidence to imply that the cities of Harappa and Mohenjo-daro were not contemporary : laid out to a common ground-plan, each with its defenced citadel towering above the rest of the town, they seem to have been twin capitals, a northern and a southern, of one united kingdom. One is reminded of historical parallels in North-West India when Sakas and Kushanas ruled from Taxila or Peshawar in the north, and Muttra in the south, over a single state.

In 1968, the Allchins, though without discarding the expression "twin capitals of this extensive state", propose to add some caution in the footnote[18] :

> It is perhaps hardly necessary to mention that this glib sentence conceals the cold archaeological truth, that up to today thre is no positive evidence that the cities were capitals, either of separate states or of a unified 'empire' ... Generations of archaeologists have felt that some such interpretation better fits the Harappan evidence than any other, but necessarily it remains hypothetical. The reader must therefore draw his own conclusions from the available data : the apparent uniformity of weights and measures, the common script, the uniformity—almost common currency—of the seals, the evidence of extensive trade in almost every class of commodity throughout the

16. B. & R. Allchin, RCIP 182.
17. Piggott PI 136.
18. B. & R. Allchin, BIC 129n.

whole Harappan culture zone, the common elements in architecture and town-planning, the common elements of art and religion. Even if the political and economic unity is admitted, there remain the profound and tantalizing problems of how it came about and how it was maintained. These have yet to be tackled satisfactorily.

But in 1983, the same archaeologists appear to be more categorical and observe :[19]

The cultural uniformity of the settlements over such a wide area leaves no doubt that the relationship between the city-centred communities of agriculturalists and craftsmen, and those who provided the means of transport and communication, must have been a stable one. This in turn indicates a strong and firmly based system which held them together and maintained their relations. Precisely what this system was and whence it drew its authority is not yet clear, but of its existence there can be no doubt, nor that it represented a special achievement in the world of the third millennium B.C.

Finally, we must remark that the indications of the superimposition of a uniform language and script (which seems to be the inescapable inference we may draw from the distribution of the sales and inscriptions), and of a uniform mythology and iconography, over so vast an area, are still and must remain sources of real wonder. They remind us of the similar indications of the rule of Asoka Maurya in the third century B.C., or of the Mughal empire at its height, although neither survived for so long as did their first model. But they are above all the indications of the first great promulgation of an interprovincial 'Indian' style, and as such they carry profound implications for the future of Indian thought and culture.

However the system came into being, it must have been built upon remarkably sound foundations, since the 'Indus Empire' appears to have lasted for around five centuries as a major cultural entity, including a number of major cities and regions, at a time when in other parts of the world the largest effective unit was little more than the city state.

In 1972, Mughal[20] observes :

The picture of the Indus Civilization, as presented to us through many years of excavation, is that of a highly disciplined society, possessing sufficient economic wealth to mobilize labour and to support full-time craftsmen. It also possessed resources to engage in long-distance trade or exchange of products. The existence of interrelated but highly developed socio-political and religious institutions, as reflected through their well-planned cities, public buildings, large fortifications,

19. B. & R. Allchin, RCIP 223-24.
20. M.R. Mughal, in Possehl's ACI 92.

granaries and standardization of material equipment through mass production, is evident. Further excavations at the same sites and new investigations at other sites are adding more detail to the picture.

Further quotations are not necessary. For at least a considerable number of serious archaeologists the impression seems to be unavoidable that there must have been a central political power enforcing its authority over the vast extent of the Indus Civilization. We shall return later to the question of the possible nature of this political power or central authority, which should be a pointer to the general theoretical climate of the Harappan culture, and therefore also to the place of science in it. For the present the point is that the channelization of the surplus from the direct producers to the city granaries, without which the Indus cities remain unexplained, was in all presumption the result of the enforcement of some central state power.

5. PROBLEM OF ORIGIN

Even in 1958, Subbarao commented : "Let it be stated straight away that in the present stage of our studies the formative stages, if any, of this great urban civilization have yet to be explored ... At present it appears to us like Minerva born in a panoply".[21] Such an observation seems to favour the view that the civilization could be an imported phenomenon. Though still endorsed by a section of the archaeologists, it does not appear to be tenable, specially in view of the work done by A. Ghose, Fairservis, Mughal and others, though the unfortunate fact remains that the archaeologists are yet to be agreed on the question of the exact account of the origin and antecedence of Harappan urbanisation. D. K. Chakrabarti in his article on *Origin of the Indus Civilization : Theories and Problems*,[22] gives us an overview of the subject, which we follow here.

In 1924, while first announcing the discovery of the Indus Civilization, Marshall observed : "there is no reason to assume that the culture of this region was imported from other lands

21. B. Subbarao, PI 95. Contrast F.R. Allchins AIC.
22. D.K. Chakrabarti, in FIC 43-50.

or that its character was primarily modified by outside influences".[21] In 1950, Piggott, substantially agreeing with this, asserted : "an origin outside India is inherently improbable, but where and in what form this origin was is quite unknown".[24]

However, Wheeler has been consistently arguing against this view. Though admitting that the Harappan culture is "too individual to be regarded merely as a Mesopotamian colony", he argued that "the idea of civilization came to the Indus from the Euphrates and the Tigris".[25]

Already in 1947-48 he[26] observed :

> And yet the idea of city-life on the developed scale of Mohenjo-daro and Harappa at a time when civic models were few and far between, combined with the certainty that the development in India was considerably later than its equivalent development in Mesopotamia and South-Western Iran, seems to impel the inference that there was some sort of causal relationship between the two. Furthermore, there is at Mohenjo-daro, in contrast for example to Ur, an indication of sudden maturity which suggests the intrusion of a perfected civic scheme... Always with the reservation that our knowledge is incomplete, we seem to have in Mesopotamia the early evolution of an idea, in India the later imposition of the idea perfected. If this inference is correct we are almost driven to suppose that the *civic idea* came to India in some fashion from Mesopotamia or South-Western Iran, but that in India it was re-created by an essentially alien, essentially Indian, cultural environment.

It is difficult indeed to follow an archaeologist when he speaks of the migration of "ideas" ignoring palpable mateiral evidences like those of script, 'seals', brick technology and many other peculiarities, from the point of view of which there is no Mesopotamian influence on the Indus civilization. But Wheeler sticks to his hypothesis and even suggests the possibility of political domination of the Harappan cities by the immigrant Mesopotamians :[27]

> There is the suspicion that the citadel-builders of Mohenjo-daro and of Harappa were innovators arriving with architectural traditions founded elsewhere upon the manipulation of mud-brick and timber, and

23. Marshall in ILN 1924 sept. 20.
24. Piggott 140.
25. Wheeler IC 93-94.
26. Wheeler in AI No. 4 91-92.
27. Wheeler IC 93-94.

imposing themselves upon a pre-existing urban population. The high-built citadels seem indeed to be forwning upon their cities with a hint of alien domination. If so, at Mohenjo-daro that domination must have been dynastic rather than cultural, for the excavations of 1950 hinted at a substantial coutinuity of culture from the pre-citadel into the early citadel phase. These and other possitibilites must be given provisional weight without any undue emphasis.

Whatever may be the rhetorical effect of the expression "frowning upon the cities", it can hardly claim even any "provisional weight" from the archaeological viewpoint. Even the *prima facie* difficulties about the conjecture appear to reduce it into a bundle of contradictions. As Chakrabarti rightly observes, it "does not explain why the dynastic domination failed to have a cultural expression. It also does not explain the genesis of his suggested 'pre-existing urban population'. Interestingly enough, Wheeler argues, on the one hand, that the Indus Civilization was too distinctive to be a colony of any alien group and suggests, on the other, that there was an alien, purely political, domination in the Harappan cities".[28]

In spite of such obvious difficulties about Wheeler's conjecture, it is somewhat strange to note that it found favour with writers like Gordon and Heine-Geldern,[29] though rejected straight-way by Lamberg-Karlovsky, who observes: "The origin and formation of the Indus Civilization have been the source of great speculation but limited evidence. For decades it was commonplace to maintain that the Indus Civilization appeared suddenly, in a mature form, around 2400 B.C., the result of diffusion from Mesopotamia. This view can no longer be maintained ... It is clear that we are just beginning to understand the prehistoric background to the formation of the Indus Civilization. There can be little doubt that when sufficient excavation is undertaken we will comprehend more fully the independent genesis of the Harappan civilization—as independent a creation as that of Egypt and Mesopotamia. Though all three civilizations were contemporary they were entirely distinctive in their form".[30] To this may be added Chakrabarti's comment: "One may only note that invoking external stimulus

28. D.K. Chakrabarti, in FIC 44.
29. *Ibid.*
30. C.C. Lamberg-Karlovsky, and J.A. Sabloff, AC: NEM 189-192.

in a vague, undefined way absolves the archaeologist of any responsibility to explain or look for culture-change in internal terms in any situation where the data are inadequate".[31]

Fortunately responsible archaeologists these days are not going in for such an easy solution of the problem of the origin of the Indus Civilization. We shall mention here only two examples.

In 1972, Mughal very successfully opens the question of the formative period of the Indus Civilization, drawing our attention not only to the significance of the earlier work of N. G. Majumdar in Sind but also to many recent excavations, like those in Kot Diji, Kalibangan, Mitathal and Siswal, Sarai Khola, Gumla, Jalilpur, Surkotada, Amri, etc. On the basis of these, he observes: "Thus, before the rise of large cities of the Indus Civilization, a widespread cultural phenomenon, constituting early, formative phase of the Harappan culture, had already set a permanent and uniform pattern of essential elements. It would seem that the processes leading to urbanization had already begun during the early third millennium B.C., but it is not possible to reconstruct these fully in the present stage of our knowledge".[32]

In 1983, Bridget and Raymond Allchin[33] have made a systematic review of "the developments of those regions which may be seen to contribute directly or indirectly to the emergence of the Indus civilization" and give us an account of the "formative stage underlying the Mature Indus civilization" which they call "the Early Indus Period." We do not have the scope to go here into the details of the archaeological data reviewed by them mainly from such sites as Amri, Kot Diji, Kalibangan, Jalilpur, Mitathal, Rahman Dheri and Tarakai Qila, and others. Nor is this necessary for our present discussion. Nevertheless, one point needs to be noted here. With all that is known so far about the formative stages of the Indus Civilization, we have still the impression of an extra-ordinarily rapid progress—

31. D.K. Chakrabarti, in FIC 50.
32. M.R. Mughal. in Possehl's ACI 94. See also, Jarrige, Jean-Francois and Richard H. Meadow, "The Antecedents of Civilization in the Indus Valley" in SA Aug. 1980. Vol. 243., No. 2, 122-133.
33. B. & R. Allchin, RCIP 131ff.

a qualitative leap as it were—from what the Allchins call "the Early or Incipient urban phase" to the "Mature Indus style". This is evidenced by "such important innovations as writing and all the implicit concomitants of political, administrative and social organization"—changes that were an "intrinsic part of the actual emergence of the cities themselves."[34] "This", observe the Allchins, "probably resulted from the successful control and exploitation of the tremendously productive agricultural potentialities of the Indus plain."[35]

6. AGRICULTURE AND AGRICULTURAL SURPLUS

That the "entire civilization flowered forth as a result of surplus agricultural economy"[36] cannot be doubted. At the same time nothing very spectacular either about the agricultural tools or about the agricultural skill is suggested by the archaeological findings of the Mature Harappan period. As Deshpande observes, "The wherewithal of the community in terms of agricultural equipment that we get at Mohenjo-daro and Harappa consisted of a solitary large hoe (Mackay, *Mohenjo-daro* pl. cvi. 56) made of flint, parallel-sided blades used for cutting corn and sickles".[37] The Allchins observe, "There is as yet comparatively little evidence for the actual tools employed for agriculture".[38]

But the most interesting evidence for agricultural technique comes from the pre-Indus period at Kalibangan, "located on the southern bank of the Ghaggar which is now dry, but must have anciently been a substantial river, as indicated by its span". In the occupation named Period I and identified as pre-Harappan is found an extensive patch of furrow-marks. B. B. Lal[39] describes it thus :

> About a hundred metres to the south of the settlement were identified the remains of an agricultural field, with some of the ploughed furrow-marks still in fact. And no less interesting is the fact that the

34. *Ibid* 167.
35. *Ibid* 166.
36. M.N. Deshpande, in IJHS V. 6, No. 1 1971. 6.
37. *Ibid* 7.
38. B. & R. Allchin, RCIP 192.
39. B.B. Lal, in EIP 69.

pattern of ploughing the field continues to be the same even now in that region. The excavated furrows formed a grid on plan. Thus, one set of the furrows was oriented east-west, while the other ran north-south. The individual furrows in the former were interspaced at a distance of about 30 cm. and those in the latter, at 1.9 m. In the crop-pattern in vogue now, horsegram is grown in the short-distanced furrows and mustard in the long-distanced ones. The choice evidently seems to depend on the size and lateral spread of the respective plants, the latter being bigger than the former.

"This finding", comment the Allchins,[40] "therefore provides a dramatic suggestion that an agricultural practice was already in use during early Indus times which has survived locally till today". "The existence of the furrows", adds Sankalia,[41] "implies that there must have been a plough. Very probably it might have been of wood". Though we do not know whether such wooden ploughs had any metal tip of bronze or copper, the furrows indisputably indicate the use of plough and thus imply that already about a couple of centuries before the Mature Harappan culture, plough for field agriculture was introduced by the pre-Harappans, because the end of the pre-Harappan Period I at Kalibangan is dated as 2700 B.C. while the beginning of Period II of Harappan culture is dated at the same site as 2500 B.C.[42]

We have mentioned all these to make only one point. The vast agricultural surplus that made possible the transition from the incipient urban phase to the urbanization of the Mature Harappan period could not be due to any sudden innovation in the agricultural tool or agricultural technique in its restricted sense. As a matter of fact, the agricultural products that filled the granaries of the Harappan cities did not presuppose a great deal of skill or improved implements. These presupposed, on the contrary, an understanding and control of annual inundation of the rivers.

40. B. & R. Allchin, RCIP 192. The discovery scraps the conjecture of D.D. Kosambi SIH 64, that "The Indus people did not have the plough (which is depicted on Mesopotamian seals) but only a toothed harrow which may be recognised as one of their Indus script ideograms".
41. H.D. Sankalia, SAPTI 63.
42. B.B. Lal, in EIP 94.

The Allchins propose to follow Lambrick, who "from his intimate personal knowledge of Sind, has been able to suggest the way in which the various crops would have been grown, and how they exploited the flooding of the Indus." Wheat and barley, the principal food grains, would have grown as spring (*rabi*)—"sown at the end of inundation upon land which had been submerged by spill from the river or one of its natural flood channels, and reaped in March or April. In modern practice such land is neither ploughed nor manured, nor does it require additional water. Lambrick remarks that 'the whole operation involves an absolute minimum of skill, labour and aid of implements'. It was the first development of this which made possible the development of Indus urbanism. Cotton and sessamum would be sown as autumnal (*kharif*) crops ; they would be sown at the beginning of the inundation and harvested at its close, in the autumn. For these fields surrounded by earth embankments would be required, most probably along the banks of natural flood channels..... Both systems are still in use, and they provided a very convincing explanation of the means by which the Harappans filled their vast granaries".[43] Yet the presumption is that since the accumulation of vast agricultural surplus must have been a precondition of the first urbanization, the control of flood in its turn was a precondition for the agricultural output. [See, however, the brief appendix to this chapter contributed by D. K. Chakrabarty].

7. BRICK TECHNOLOGY AND HARAPPAN CULTURE

This leads the Allchins to emphasise the importance of brick technology—or, more specifically the technology of making and using burnt bricks—for the Harappan urbanization. As they[44] put it :

> We have already mentioned the environment of the Indus Valley and the opportunities it offered once the annual innundation had been understood... A vital necessity of settlement in the Indus plain itself would have been flood defence, and here it seems that burnt-brick must have played an important role. For, in these areas where stone was not readily available (and this includes the majority of the Harappan

43. B. & R. Allchin, RCIP 192
44. *Ibid* 167.

sites) mud-brick would have been rapidly destroyed by rain or flood water. Thus the discovery and utilization of burnt-brick was one factor. It has sometimes been suggested that the Indus Valley could not have produced sufficient timber for this operation... However, Lambrick, writing with many years of administrative experience of Sind, has shown that timber growing along the riverine tracts today is sufficient for all the burnt-bricks made in the province, and anciently cannot have been less abundant.

We may not yet have a very precise knowledge of where and when in the Harappan cultural area the technique of making and using burnt bricks took definite shape and eventual sophistication. Reviewing the developments of those regions which may be seen to contribute directly or indirectly to the emergence of the Indus civilization, the Allchins note that such sites as Mundigak IV,[45] Damb Sadaat,[46] Amri,[47] Kot Diji,[48] Gumla[49] Rahman Dheri[50] and Kalibangan[51] are, generally speaking, indi-

45. B. & R. Allchin, RCIP 133-34 ; J.M. Casal, *Fouilles de Mundigka*, Paris : 1961 ; H.D. Sankalia, in PPIP 314-15 ; W.A.Jr., Fairservis, RAI 122-34, Mughal EHPGIVNB 293ff.
46. B. & R. Allchin, RCIP 134-35 ; Fairservis RAI 319ff ; Mughal EHPGIVNB 225-259.
47. B. & R. Allchin, RCIP 141 ; J. M. Casal, *Fouilles d'Amri* Vol. I, Text. Paris : 1964 ; Sankalia PPIP 331-37 ; Fairservis RAI 175-79 ; M.R. Mughal EHPGIVNB 84-87.
48. B. & R. Allchin, RCIP 145 ; F.A. Khan, "Excavations at Kot-Diji" in *Pakistan Archaeology*, 1965, 11-85 ; H.D. Sankalia, PPIP, 338-42 ; Fairservis RAI 179-84 ; Mughal EHPGIVNB 50ff ; Sankalia in *Antiquity* 1969, 142-44.
49. B. & R. Allchin, RCIP 150 ; A.H. Dani, "Excavations in the Gomal Valley" in *Ancient Pakistan* 1970-71, 1-177 ; Sankalia PPIP 329-31 ; Jim G. Shaffer, "The Indus Civilization : New evidence from Pakistan" in EIP 18-20.
50. B. & R. Allchin, RCIP 150.
51. B. & R. Allchin, RCIP 157 ; Aurel Stein, "A Survey of Ancient Sites along the 'lost' Sarasvati River" in *The Geographical Journal* vol. 99. 1942, 173-182 ; A. Ghosh "The Rajputana Desert. Its Archaeological aspects" in *Bulletin of the National Institute of Sciences of India*, No. 1. 1952, 37-42 ; H.D. Sankalia, PPIP 342ff ; B.K. Thapar, "Excavations at Kalibangan" in *Cultural Forum*, July 1967 ; B. K. Thapar, "Kalibangan : A Harappan Metropolis beyond the Indus Valley" in Possehl's ACI 196-202 ; B.B. Lal, "Kalibangan and Indus Civilization" in EIP 65-97 ; M.R. Mughal, EHPGIVNB 81.

cative of the practice of using sun-dried mud-bricks. But there are also indications of steps being taken towards the making of burnt bricks already in the formative stages of the Harappan culture. We mention here two evidences, namely those of Kalibangan and Banwali.

To Aurel Stein, Kalibangan seemed to "offer interest as marking an extensive site used mainly for burning bricks". He had observed that the two "mounds are composed almost entirely of kiln remains and the painted sherds found among them leave no doubt about the Klin having been worked down to the Kushan period." However, as B. K. Thapar observes, "Stein had obviously failed to identify the Harappan remains including pottery. The scatter of brickbats and potsherds noticed by him on the mound represented in facts the telltale evidence of brick-robbing resorted to at the site for laying the Hanumangarh-Suratgarh section of the rail-track; coincidentally a parallel situation to that of Harappa".[52]

To the story of Harappa we shall presently come. For our immediate discussion the point to be noted is that in Kalibangan we come across the technique of making and using burnt bricks already at the pre-Harappan stage. The data so far published about Kot Diji, as the Allchins[53] sum up, "give us little information regarding house plans. However, throughout these five periods at Kalibangan, both dried brick and stone were used, domestically and for town walls. At this same site there appears already to have been a standardization of brick sizes and although the ratio (3 : 2 : 1) differs from that of the Mature Harappan period, it clearly suggests the way in which the Early Indus anticipates what is to follow". To this needs to be added the following. At Kalibangan, in the pre-Harappan level baked bricks were used as is evidenced by a drain of this level which was made of burnt brick 30 X 20 X 10 cm.[54]

The anticipation of burnt brick in the pre-Harappan stage is also evidenced by Banwali in the Hissa district, Haryana. The culture assemblege gathered during excavations here are assigned to three periods, of which Period I represents Pre-Indus or Kali-

52. B. K. Thapar, in FIC 5. The distance between Hanumangarh and Suratgarh is about 30 miles.
53. B. & R. Allchin, RCIP 157.
54. IAR 1967-68, 45. See also, IAR 1962-3, 20.

bangan culture. This has revealed "bricks, both fired and sun-dried", which were moreover "meticulously standardized, conforming to the ratio 1 : 2 : 3. This ratio was observed earlier at Kalibangan. But the dimensions at Banwali are 12 by 24 by 36 centimetres and 13 by 26 by 39 centimetres as compared to 10 by 20 by 30 centimeters at Kalibagan. In addition there is one aberrant size 24 by 24 centimetres, the thickness remaining still indeterminate".[55]

But all this is yet far from what we come across in Mature Harappan culture, mud-brick being generally used in the pre-Harappan period, inclusive of Kalibangan. "The pre-Harappans lived in well laid-out houses... These were made of mud-bricks whose size was the same as in the case of the fortifications-walls. The style of the masonry was that of placing headers and stretchers in alternate courses, which is commonly known as the English bond. Evidence of plastering the walls with mud and chaff was also available".[56]

In the Mature Harappan Culture, however, we are confronted with an "explosion" as it were in the technique of making and using burnt bricks. The scale which the manufacture of burnt bricks assumed appears literally staggering. Piggott tell us the story of how William Brunton in the mid-nineteenth century plundered the ruins of ancient Harappa for obtaining ballast for the railway line being constructed under his guidance from Lahore to Multan, and, as a result of this, "today the trains rumble over a hundred miles of line laid on a secure foundation of third-millennium brick-bats".[57] What survives this massive brick-robbing in Harappa alone is, to say the least, most imposing. To this is to be added the evidences of brick-robbing for laying the railway line from Hanumangarh to Suratgarh just quoted from Thapar. Besides, what remains at such sites as Harappa, Mohenjo-daro, Kalibangan, Lothal, etc., is imposing, though in Lothal the use of burnt bricks was restricted mainly to the "building of baths, drains and dock which had to be impervious to water".[58]

55. R.S. Bisht, in Possehl's HC 115.
56. B.B. Lal, in EIP 68.
57. Piggott 14.
58. S.R. Rao, *Lothal* (MASI, No. 78) 71.

On sheer quantitative considerations, the manufacture of burnt bricks in Harappa culture is most imposing.

8. BRICKS IN THE FIRST URBANIZATION

We shall try to go here into some detail of brick technology and its evolution in First Urbanization, because, as we shall see, it has very important bearing on our understanding of the making of mathematics in ancient India.

The quantitative considerations apart, what has amazed the archaeologists about brick technology of the Harappan culture is the quality of the bricks used in various types of constructions. Mackay, to whom we owe the first descriptive account of the bricks in Mohenjo-daro, observes:[59] "Well-burnt bricks, and those of Mohenjo-daro are of excellent quality, are practically indestructible and can be used over and over again, provided that a moderate amount of care is taken in removing them from the old walls."

The bricks of Mohenjo-daro are all exceptionally well made, yet have no straw or other binding material. They are always rectangular in shape with the exception of those that were made for special purposes, such as the wedge-shaped bricks almost invariably employed in the construction of wells. The bricks were made in an open mould and struck along the top with a piece of wood, as proved by their streated upper surfaces... The clay that was used seems to have been ordinary alluvial soil like that which is found in the vicinity of Mohenjo-daro today, and is used by the modern brick maker and potter. It is only necessary to dig down a few feet below the surface soil, which is impregnated with salt, to obtain clay of the right consistency... The bricks are exceptionally well baked and range from straw colour to bright red... We do not yet know the type of kiln in which these bricks were baked, but, then as now, there was evidently no difficulty about fuel. Wood must always have been far more plentiful than in Babylonia, where reeds were the only available fuel... As in all brickyards of the modern East, the bricks were laid over large areas for the preliminary drying. The result is that we have found the foot-prints upon them of cattle, crows, dogs... The largest brick yet found at Mohenjo-daro measures 20.25 by 10.5 by 3.5 inches... It was probably made originally to cover a drain... Another brick of large size measures 14.5 by 7.25 by 4 inches. This size of brick is fairly common... The smallest size brick measures 9.5 by 4.35 by 2 inches... In the construction of the bathrooms,

59. Mackay in Marshall's MIC I. 262.

sawn bricks were almost invariably used to ensure the evenness of floor which was considered essential.[60]

Mackay[61] gives the following list of the various sizes of bricks used :

	Size in inches	
1.	9. 5 × 4.35 × 2	Sawn
2.	10. 0 × 5.00 × 2.25	„
3.	10. 0 × 5.00 × 2.25	„
4.	10.25 × 5.50 × 2.25	„
5.	10.25 × 5.00 × 2.25	Moulded
6.	10.35 × 2.50 × 2.00	Sawn
7.	11.00 × 5.25 × 2.35	Moulded
8.	11.00 × 5.50 × 2.25	„
9.	11. 4 × 5.75 × 2.5	„
10.	12.00 × 6.00 × 2.25	„
11.	13.50 × 6.25 × 3.75	„
12.	14.00 × 6.75 × 3.75	„
13.	14.00 × 7.00 × 3.25	„
14.	14.50 × 7.25 × 4.00	„
15.	20.25 × 10.50 × 3.50	„

"By far the commonest size of moulded brick is 11 by 5.5 by 2.25 inches ; it occurs at all levels. The moulded brick of small size (no. 5) is very unusual ; possibly it was made for a special purpose... We have not yet succeeded in finding any brick-kilns, but these were probably situated well outside the city area and near an ample supply of wood".[62]

Let us note here specially one point. By far the most commonly used brick in Mohenjo-dado, according to Mackay's mesurement, is 11×5.5×2.25 inches. Basically speaking, this gives us a proportion of 4 : 2 : 1, though with slight discrepancy about the thickness of the brick (which, according to this proportion, should have accurately been 2.75 inches).

Later archaeological work wants us to look at this proportion of 4 : 2 : 1 as having been on the whole characteristic of the standard bricks of Mature Harappan culture. But there are some points to be noted in this connection.

60. *Ibid* 266-67.
61. *Ibid* 267.
62. *Ibid* 268.

The two sites, namely Kalibangan and Banwali, as we have noted, indicate for us the making of burnt bricks already in the pre-Harappan stage, though its use was restricted. The restriction to the use of burnt bricks continued in the Mature Harappan period at both the sites, mud bricks being more generally used also in the Mature Harappan stage. It seems, however, that there is a noticeable change from the pre-Harappan to Harappan stages in the size (and proportion of the different dimensions) of both mud bricks and burnt bricks most commonly used at both the sites. In the pre-Harappan stage at both Banwali and Kalibangan, the proportion of the dimensions of the standard bricks seems to have been 3 : 2 : 1, whereas in the Harappan period it assumes the proportion of 4 : 2 : 1.

In Kalibangan Period I (pre-Harappan), as B.K. Thapar says, "the fortification wall was made of mud bricks (30×20×10 cm ; proportion, 3 : 2 : 1)... The use of baked brick was attested by a drain, the size of the brick being the same as that of mud bricks".[63] Discussing the citadel in Kalibangan Period II (Harappan), Thapar continues : "The fortifications were built throughout of mud bricks ; two sizes of bricks, 40×20×10 cm. and 30×15×7.5 cm. (ratio 4 : 2 : 1) representing two principal structural phases, were used in the construction, the larger bricks in the earlier phase and the smaller in the later... The enclosed area contained some five to six massive platforms of mud bricks (40×20×10 cm. for the earlier phase and 30×15×7.5 cm. for the later)".[64] In the entrance complex of the citadel, again, "two structural phases were recognized, of which the earlier consisted of steps built of mur bricks (40×20×10 cm.) with a riser of 10 cm. and a tread of 40, and the later, perhaps of a ramp, screened by a 1.5 m.-wide wall (30×15×7.5 cm.). Lest the unwary reader carry the impression that in Kalibangan during Period II (Harappan), the small-sized bricks, viz. 30×15×7.5 cm. were introduced only in the later phases, it may be said that bricks of this size have been used right from the beginning of the

63. B.K. Thapar, in Possehl's ACI 197.
64. *Ibid* 199.

occupation for domestic structures. It was only in the fortifications and massive platforms that the large-sized bricks were employed in the earlier phases and smaller ones in the later. It is significant, however, that the ratio of dimension of both sets remains 4 : 2 : 1" [65] The baked bricks, the use of which was confined mostly to drains, had also the same size : 30× 15×7.5 cm. i.e. the proportion 4 : 2 : 1.[66] To sum up : In Kalibangan, the transition from the pre-Harappan to Harappan stage indicates also some change in the technique of brick-making, the most conspicuous of which was the change in the proportion of the bricks from 3 : 2 : 1 to 4 : 2 :1.

The same seems to be indicated at Banwali. Referring to Period I (called pre-Harappan or Kalibangan Culture), R.S. Bisht observes, "The bricks, both fired and sun-dried, were meticulously standardized, conforming to the ratio 1 : 2 : 3. This ratio was observed earlier at Kalibangan. But the dimensions at Banwali are 12 by 24 by 36 centimetres and 13 by 26 by 39 centimeters, as compared to 10 by 20 by 30 centimeters at Kalibangan".[67] In Period II, representing Mature Harappan Culture, there is a noticeable change in the proportion of the dimensions of the bricks. "Bricks, both baked and sun-dried, were carefully moulded into various sizes which, except the wedge shaped examples, form two broad groups and always give the ratio of 1 : 2 :4 as regards thickness, width and length. The smaller bricks which variously measure 6 by 12 by 24 centimetres ; 6.5 by 13 by 26 ; 7 by 14 by 28 ; 7.5 by 15 by 30 or 8 by 16 by 32, were used in constructing residential houses. The larger ones, 10 by 20 by 40 centimetres ; 11 by 22 by 44 ; 12 by 24 by 48 and 12.5 by 25 by 50 were used in massive structures such as defences. Fired bricks are normally used in drains, wells and bathing platforms : places with a constant use of water."[68]

In Lothal, the basic proportion of "1 length : 2 breadths" appears to have been generally maintained for the bricks, though there were slight variations in the proportion of thick-

65. *Ibid* 200.
66. Ibid 201.
67. R.S. Bisht, in Possehl's HC 115
68. *Ibid* 118.

ness. Here is how S.R. Rao[69] sums up the evidences for Lothal bricks :

The Lothal folk did not use kiln-fired bricks for building houses and platforms. They used mostly sun-dried bricks for this purpose... As the climate has not changed much since three thousand years it may be presumed that the rainfall was not very heavy and there was no need of kiln-fired bricks except for building baths, drains and dock which had to be impervious to water. Two types of mud-bricks are easily distinguishable at Lothal... The most common size is 11×5½×2½ in., but some vary from 12×6×3 in. and 14×7×3 in. to 15×8×3½ in. Besides the kiln-fired bricks were well moulded and fired : common size 11×5½×2½ in. a smaller size measures 9½×5×2½ in. Radial bricks used in the construction of the wells and the curves of drains are 9½ in. long, 3½ in. thick, and 4½ in. wide at one end and 3½ in. at another. Small bricks measuring 3×2×1 in. and T-shaped bricks were also used in the openings of the drains. A remarkable feature of the masonry of the Harappan sites is the standardization of the size of bricks namely 11×5½×2½ in. for most of the constructions throughout the vast area covered by the Harappan Civilization. Another noteworthy feature of standardization is the maintenance of a suitable proportion between the length and breadth of the bricks. Whether sun-dried or kiln-fired, the bricks measure 1 length : 2 breadths, e.g. 11×5½ in. in the case of baked bricks. Apparently, the Harappans must have realized the necessity of maintaining the said proportions with a view to use complete bricks as headers or stretchers in achieving the required thickness of the walls. If the most common size of the mud-brick is compared with the most common size of the baked-brick the difference is within the limits of the permissible fire-shrinkage, namely 8 to 15 percent. This difference further suggests that the moulds were of common size for mud-bricks as well as the burnt ones. Thus it is obvious that the bricks were burnt not only to modern standards but also on modern principles. They have sharp right-angled edges and the sides are parallel.

With this data in mind we may now quote the general observations of K.N. Dikshit[70] on brick technology in the Indus Civilization and after :

The bricks used for the building of houses in Mohenjo-daro and Harappa are well burnt and of excellent proportions, which have excited the admiration of modern engineers in Sind. The most usual size of burnt bricks is 11 by 5½″ or 5½″ with a thickness of 2½″ to

69. S.R. Rao, *Lothal* (MASI, No. 78) 71-72.
70. K.N. Dikshit, 15-16.

2¼". At no other period has the Indian builder ever struck upon this most business-like size of bricks, and it is remarkable that the evolution of bricks in the historic period from Asoka commences with bricks of about double the length and breadth of the Indus Valley brick. It gradually diminishes in the Kushana, Gupta and mediaeval periods, but never attains the true proportion of length, breadth and thickness as 1 : ½ : ¼, which makes for an excellent bond. That this ideal proportion was not entirely forgotton is shown by the fact that a later text (*Kasyapa Samhita*) prescribes a proportion of 10 fingers of length to 5 fingers of width and half of the latter for thickness; but it is doubtful whether in actual practice the masons ever followed this in the historic period. Any way, it is clear that the burnt brick of the Indus Civilization has been unexcelled in India and is not comparable with any attempts made in ancient Sumer, Egypt and other countries, till we come down to the Roman times.

Two points about this observation may be specially noted.

First, the standardization of the brick size in the Harappan culture—the basic proportion of 4 : 2 : 1 of the dimensions of the bricks—is indicative of a significant advance, inasmuch as it creates scope for very efficient bonding and therefore also improved masonry and architecture.

Secondly, after noting the excellence of brick technology of the Indus civilization, Dikshit skips over a very long period and takes up the story of the bricks from the time of Asoka. Evidently, from the Maurya period onward, brick technology in India had to reacquire progressive improvement in the still later periods of the Kushanas, Guptas and the medieval times. In any case, Dikshit is absolutely silent about any brick technology in the period intervening between the Indus civilization and the time of Asoka. Why is he thus silent? The answer is quite on the surface. There is no evidence for brick technology in this intervening period, which, chronologically speaking, covered more than ten centuries. In other words, brick technology is conspicuously absent during the "Dark Age" or "Dark Period" intervening the two Urbanizations, notwithstanding an insignificant number of stray evidences like those in Bhagwanpura, Dadheri, etc.,[71] about the exact implications of which the archaeologists are yet to be clear and, in any case, the few burnt bricks found in such sites are not indicative of any brick technology worth taking serious notice of.

71. T.N. Roy, GC 130f.

To sum up this discussion: According to the periodization we have proposed—

(a) the First Urbanization is unmistakably indicative of the tradition of highly sophisticated brick technology, or of the technology of making and using burnt bricks,
(b) the intermediate Dark Period is unaware of it,
(c) the Second Urbanization is indicative of the re-introduction of this technology, though beginning again in a rather humble form.

With these points in mind we proceed to the question of the making of mathematics in ancient India, which, as we are going to see, is inextricably connected with brick technology.

BRIEF APPENDIX

ON AGRICULTURAL TECHNOLOGY AND HARAPPAN CULTURE

by

D. K. Chakrabarti

[When I met D. K. Chakrabarti in Delhi sometimes back, he told me that he was then working on a paper on the agricultural technology in Harappan Culture. Having as I do a good deal of admiration for his work, I immediately requested him to allow me to use his essay as an appendix to my present work. He was kind enough to agree to this. However, it was then almost on the eve of the present manuscript to go to the press and Chakrabarti was evidently in need of some reasonable time to complete the essay in full form. In view of this, he suggested that he would sum up his main points cryptically, so that I could use these as a brief appendix in my work. I am extremely grateful to him for the following note he has sent in the form of personal communication, so that his main ideas could at any rate be communicated to the readers, awaiting of course the publication of his full article: Debiprasad Chattopadhyaya].

"I only wanted to put emphasis on the following points regarding Harappan agriculture :

1. The agricultural ancestry of the Harappans goes back to the 7th millennium B.C. at Mehrgarh in the Bolan valley of the Kachchi plain, and this simple fact suggests that by the time the Harappan civilization came into existence (*c* 2900-2800 B.C.), its agricultural pattern must have been laid out in considerable detail in the earlier—"Early Harappan"—period. The data on the early Harappan agriculture are still meagre, but one remembers the large quantity of wheat at the early Harappan site of Tarakai Qila in the NWEP area.

2. It may be wrong to imagine the Harappan agricultural system within a uniform framework. The agricultural pattern pursued in different areas of its distribution must have been to a great extent different, although our specific ideas are not clear at present. The Nile-like seasonal overflow and the consequent easy cultivation system which H.T. Lambrick postulates for Sind could not very well be true of Punjab, or for that matter, of Gujrat. Double-cropping was possible in all the suitable areas.

3. The Harappan agricultural system seems to show an evolutionary pattern of its own. *Bajra* seems to be peculiar only to the late Harappans in Gujarat. Legumes are specific to the late Harappans in Western U.P. (cf. Hulas). This suggests interaction between the late Harappan agriculture and the neolithic-chalcolithic agriculture of inner India. This is a point which has become sharp in recent years.

4. The terracotta model of a plough at Banawali sets at rest all the hypotheses about the use or non-use of plough in the Harappan civilization.

5. The existence of irrigation canals in the Harappan context has been argued by the French team working on the problem (*Man and Environment*, 1986). This opens a new vista of research.—*D. K. Chakrabarti.*